MICROBIAL DIVERSITY AND DYE DEGRADATION ANALYSIS OF TEXTILE WASTE WATER

A

RESEARCH PLAN

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CONTENTS

1. Introduction	3
2. Review of Literature	3
3. Objectives	6
4. Methodology	6
5. Research outcomes	7
6. References	7

INTRODUCTION

Over last few decades, increasing globalization, urbanization and industrialization has cause different environmental pollution. Textile industry plays an important role in the economy of our country but it is one of the main sources of pollution problem worldwide.

In the Thar Desert of Western Rajasthan where water resources are limited, textile hand processing industries operate in Pali, Jodhpur and Barmer (Balotra) district. According to a statistical data survey one million tons of dyes are produced annually and more than 10,000 thousand dyes are used in the textile industry. The toxicity of most of the dyes is one of the serious environmental concerns, as effluents come from dye processing industries are known to be carcinogenic as well as mutagenic to various organism. Around 760 hand processing textile units in Pali and 650 textile units in Jodhpur alone discharge about 18 million litres and 7 million litres effluents per day respectively. Release of textile industry effluent into water bodies creates a major threat to the human health.

There is a great need to develop an economical and effective way of dealing with the textile dyeing waste in the face of the ever increasing production activities. A lot of research on the treatment of textile dye stuff and effluent waste water has been carried out using individual plant and microbial cultures.

REVIEW OF LITERATURE

The textile effluent comprise of industrial waste water including dyes and carcinogenic heavy metals. These discharges and their effects are studied here.

Meena and Nama, 2017, concluded that the textile industrial effluents were adversely affecting on the water quality which effects on aquatic environmental as well as the human life of the surrounding.

In 2015, Tabassum *et al.*, reported that the huge quantities of wastes and sludge discharged from industries might be responsible for the enrichment of all physicochemical parameters at discharging point.

Krishnan *et al.*, 2016 reported that Dyes usually have a synthetic origin and complex aromatic molecular structures, which possibly come from coal-tar based hydrocarbon.

Vijayanandini *et al.*, 2016 illustrated that generally the azo dyes contain one, two or three azo linkages, linking phenyl, naphthyl rings that are usually substituted with some functional groups including triazine amine, chloro, hydroxyl, methyl, nitro, and sulphonate.

Al-Musharafi, 2016 concluded that either free or complex ionic forms of zinc, lead and cadmium are discharged by various industries, such as textile industries. The continuous discharge of heavy metals into the environment and their accumulation cause adverse effects.

Sudha *et al.*, 2014 demonstrated that dyes are totally decomposed to low-molecular weight compounds like CO_2 and H_2O using conventional and microbial bioremediation. They involve a minimal capital investment and an easy and fast operation procedure.

Rajamohan and Rajasimman, 2013 mentioned the textile effluents usually contain azo dyes which are highly resistant to biological treatment and these dyes are considered to be 4recalcitrant xenobiotic compounds because of the presence of N=N bonds and other possible groups, like the sulphonic group, which are tough to be degraded.

Bioremediation is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site (NRC, 1993). Oyet and Audu, 2016 reviewed that Bioremediation is eco-friendly, non-invasive, cheaper than conventional methods, and it is a permanent solution that can end with degradation or transformation of environmental contaminants into harmless or less toxic forms.

At present, number of studies has focused on several microorganisms belonging to different taxonomic groups of fungi, bacteria and yeast proved their ability to decolorize a wide range of dyes by bioadsorption, biotransformation and degradation. However, the effluent from biodegradation of dyestuffs could be toxic.

The basic step in the decolorization and degradation of dyes is to breakdown of bonds (used in specific dye) leading to removal of color. Sometimes, reverse coloration may take place when the degradation products are exposed to oxygen. Also, only few research works have been reported on the aerobic degradation of azo dyes. Because of these problems, application of bacterial degradation is limited.

Lade *et al.*, 2012 and Lin. *et al.*, 2010, reported that some bacterial cultures are able to reduce azo compounds aerobically with the help of oxygen catalyzed azo reductase but also produce aromatic amines.

Tripathi and Srivastava, 2011 reported that for complete mineralization of Azo dyes the microbial population forming part of treatment system should be able to work efficiently under both aerobic and anaerobic condition.

In 2014, Sudha *et. al.,* on focusing the above mentioned problem described in their review that microbes could decolorize the dyes by both aerobic and anaerobic metabolism. The process is called Bioagumentation.

Ayed *et al.*, 2013 reported the decolorisation of triphenylmethane dye fushine, Malachite Green and Crystal Voilet by *Staphylococcus epidermis* isolated from contaminated soil.

Shah *et al.*, 2017 mentioned that *Sphingomonas paucimobilis*, showing highest capacity of decolorization of Dark Red 2B azo dye up to 98.46%.

Biodegradation of single dye using microbes was reported extensively in the literature, but studies on mixture of dyes are very limited. Saratale *et al.*, 2011 has reported that the textile and dyeing industries release waste water containing a mixture of dyes in to the environment.

In 2016 by Govindan *et al.,* the wide range of aerobic and anaerobic bacteria such as *Bacilus subtilis, Pseudomonas* sp, *Escherichia coli, Rhabdobacter* sp, *Enterococcus* sp, *Staphylococcus* sp, *Xenophilus* sp, *Corneybaterium* sp *Clostridium* sp., *Micrococcus dermacoccus* sp, *Acinetobacter* sp, *Geobacillus, Lactobacillus, Rhizobium, Proteus* sp, *Morganella* sp, *Aeromonas* sp, *Alcaligenes* sp, and *Klebsiellla* sp. have been extensively reported as degraders of azo dyes and heavy metals use in Industries.

Bestway *et al.*, 2013 *Enterobacter sp., Stenotrophomonas sp., Providencia sp., Chryseobacterium sp., Comamonas sp., Ochrobactrum sp. and Delftia sp.* able to resist 275 mg Cu/l, 320 mg Cd/l, 140 mg Co/l and 29 mg Cr/l respectively.

Countries suffering from water shortages are forced to use non-conventional resources, mainly water harvesting and treated waste water. Vegetable cultivation with the waste water nowadays has been a common practice worldwide.

Saini, *et al.*, 2014 has mentioned in their study that the industrial effluents, in lower quantities provide macro and micro nutrient requirements of the plants. But higher quantity becomes harmful.

The use of plant and microbes to reduce the concentrations or toxic effects of contaminants in the environment, process said to be phytoremediation. These involve different processes such as stabilization or degradation and removal (volatilization or extraction) of contaminants. .

Dixit *et al.*, 2015 concluded that the plants perform the immobilization of heavy metals in soils by sorption through roots, precipitation, complex formation or metal valence reduction in the rhizosphere. Many such plants have been utilized for phytoremediation. Castor *(Ricinus communis)*, Corn *(Zea mays)* Jatropha *(Jatropha curcas L.), Brassica juncea* and *Astragalus bisulcatus* are some examples more which have been utilized for phytoremediation of heavy metals like Zn, Hg, Cd, Cu, etc

Greipsson. 2011, reviewed that soil microbes can decrease toxic effects of contaminants in the soil. Exudates (peptides) from the bacterium *Pseudomonas putida* can decrease Cd toxicity in plants. Plants can also convert contaminants into less toxic forms, or decrease their bioavaibility. Poplar trees (*Populous spp.)* have been used successfully in phytodegradation of toxic and recalcitrant organic compounds. Hybrid poplar trees have been used to volatilize trichloroethylene (TCE) by converting it to chlorinated acetates and CO_2.

Shah *et al.,* 2014 demonstrated that local indigenous microflora biomass is significantly better at biodegradation/ biodecolorization that commercially obtained once.

Forss *et al.*, 2017 also reported that microbial processes can substantially contribute to efficient and reliable degradation of actual textile wastewater. Thus, development of biodegradation systems holds promise for application of affordable wastewater treatment in polluted environments.

Therefore a need exists to develop a novel treatment technology for textile dye effluent treatment to ensure environmental protection from these harmful pollutants. Environmental

Biotechnology is constantly expanding its efforts in the biological treatment of heavy metals and dye-contaminated waste water.

The best of our knowledge no information exist about the biodecolorization potential of local microbial isolates from Textile Effluent waste water discharge into Jojari river, and its effect on vegetable plant when using the untreated waste water in irrigation in Jodhpur Rajasthan.

OBJECTIVES

- Screening and Sampling of waste water and soil.
- Physico-chemical analysis.
- Biochemical and Molecular characterization of Microbial strains.
- Dye Decolorization using selected microbial strains.
- Studies on selective vegetable crops for bioaccumulation.
- FT-IR studies.

METHODOLOGY

- Sites will be finalized for the sample collection after analyzing the environmental issues.
- In the first phase of study samples will be collected from polluted areas and various microbes will be isolated using serial dilution method.
- Isolated microbes will be cultured using various media.
- Industrial waste water samples will be processed to find out various contaminants.
- Physico-chemical and Heavy metal analysis of samples using AAS etc.
- Screening will be done with respect to selected Industrial dyes.
- Experiments will be conducted for evaluation of bioremediation potentiality of different microbial strains.
- Identification of microorganisms at molecular and Biochemical level.
- Submission of gene sequences to N.C.B.I.
- Morphological studies of selected vegetable crops.
- Experiments will be conducted for evaluation of remediation potentiality of some vegetable crops towards Industrial Dyes.
- Results will be analyzed on the basis of observing plant morphology, estimating the contents of plant and decreasing amount of dyes in soil by appropriate techniques.
- Preparation of final technical report.

RESEARCH OUTCOMES

1. Identification of Microbial Flora found at selected contaminated Sites.
2. Identification of efficient microbial strain having potential toward the decolorization of Industrial Dyes.
3. NCBI submission of novel strain.
4. Evaluation of capability of Selected Vegetable Crops toward phytoremediation to remove dyes having heavy metals from soil.
5. Vegetable Crops having ability to uptake the dye as nutrient source without any negative impact will be used for further studies.
6. Either a fruitful or negative result will be used to make society aware
7. Encouraging the private initiatives for best environmental biotechnology approach.

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